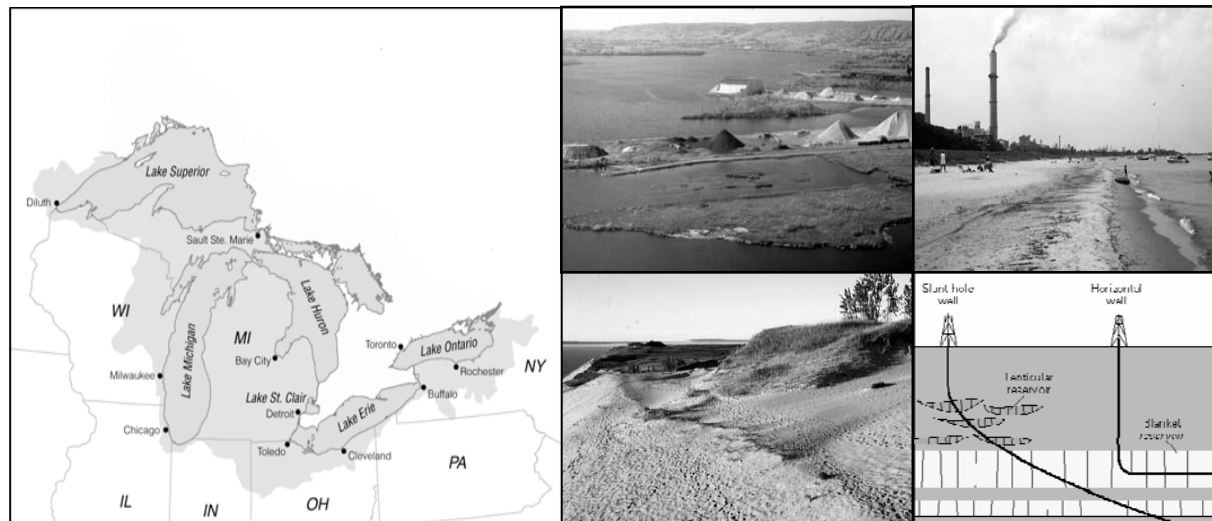




# ***Known & Potential Environmental Effects of Oil and Gas Drilling Activity in the Great Lakes***

**Megan Hurst: U.S. Army Corps of Engineers,  
Chicago District**

**Dr. Ihor Hlohowskyj: Department of Energy,  
Argonne National Laboratory**





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# *Agenda*

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- **Authority, Purpose, and Scope**
- **Study Team and Approach**
- **Report Summary**
  - **Study area and resources**
  - **Oil and gas exploration and drilling technology**
  - **Oil and gas release incidents**
  - **Potential effects**
- **Summary and Conclusions**



## ***Study Authority***

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- **Section 503 of the Energy and Water Appropriations Act of 2002 directed USACE to:**
  - “Conduct and submit to Congress a study that examines the known and potential environmental effects of oil and gas drilling activity in the Great Lakes (including effects on the shorelines and water of the Great Lakes).”***
- **Study requested by House Energy and Water Appropriations Subcommittee in June 2004.**
- **Energy and Policy Act of 2005 placed permanent ban on Great Lakes oil and gas drilling.**
- **Final report submitted in March 2006.**



# ***Study Purpose and Scope***

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- **Purpose:**
  - **Identify potential environmental effects of oil and gas development in the Great Lakes**
  - **Does not address or recommend Federal action**
- **Scope:**
  - **Great Lakes Basin (the Basin) and its natural and socioeconomic resources:**
    - **5 Great Lakes**
    - **8 States**



## ***Study and Review Teams***

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- **Project lead: USACE Chicago District**
  - **Funded at \$498K**
- **DOE-Argonne National Laboratory selected to conduct study and prepare report**
- **Technical Review**
  - **USACE Review Team**
  - **Independent Subject Matter Experts**



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## ***Study Approach***

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- **Review and synthesize existing information**
- **Identify potential effects from exploration, construction, and production**
- **Identify mitigating factors**
- **Identify uncertainties and data gaps**



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## ***Uncertainties and Data Gaps***

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- **Status of oil and gas reserves**
- **Location of natural and cultural resources**
- **Spills from current wells and pipelines**
- **Spill response times**
- **Spill cleanup effectiveness**
- **Future advances in spill containment and cleanup**
- **Advances in drilling capabilities and technology**



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# ***STUDY AREA***







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# *The Great Lakes Basin*

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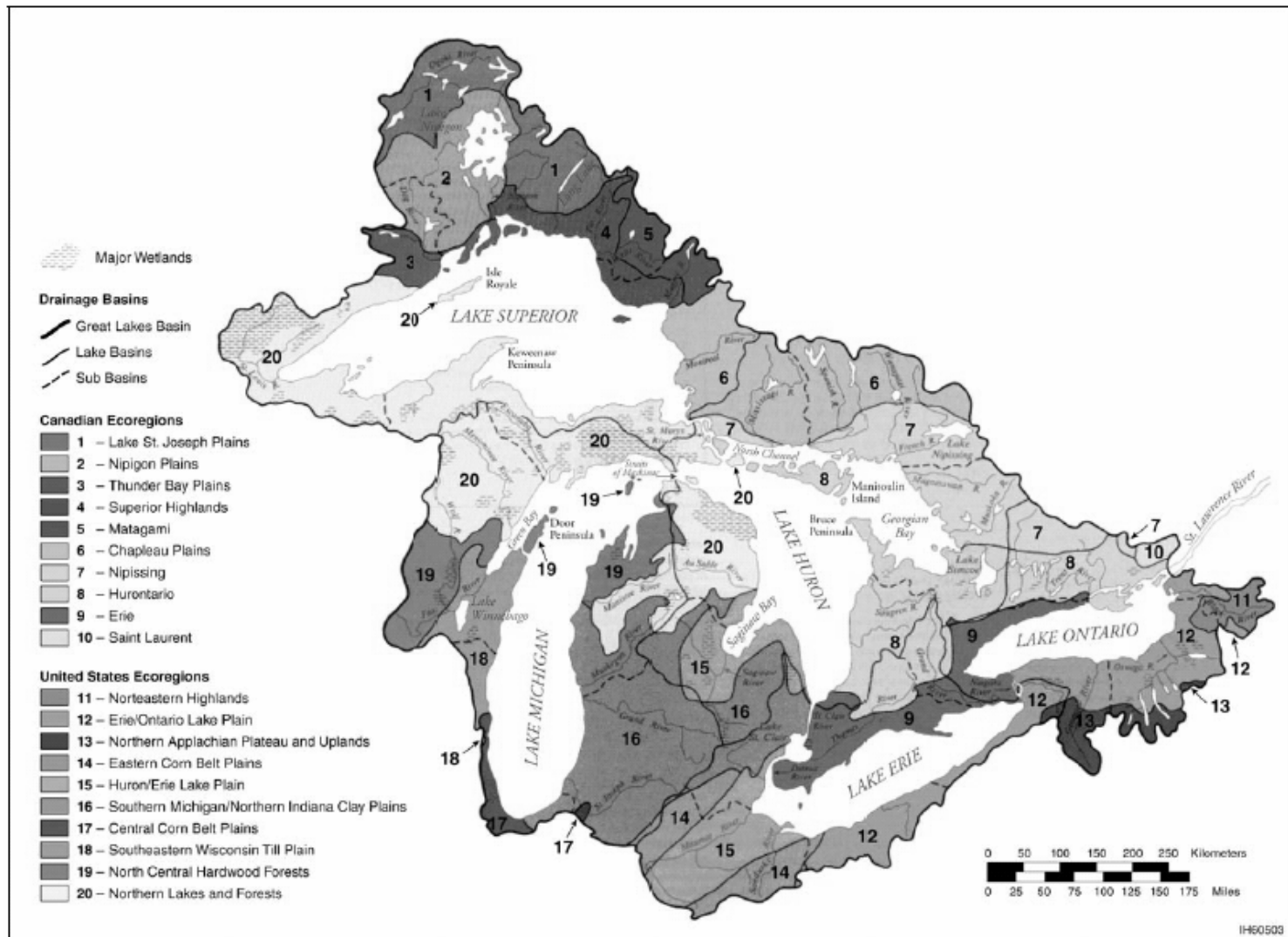
- **U.S. portion of Basin:**
  - **8 States**
  - **5 Great Lakes**
  - **197,000 sq. mi.**
- **Diverse physical and biological environment**
- **24% of North America's water supply**
- **29% of U.S. population, 16% US GDP**





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# Ecological Resources





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# *Vegetation*

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## **Diverse coastal and inland plant communities:**

- **Coastal wetlands**
- **Unique coastal communities**
- **Inland plant communities**
  - **Mixture of forest and agriculture**



**Drowned River Mouth Wetland**





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## ***Fish and Wildlife***

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- **More than 170 species of fish live in the Basin (over 150 native species)**
- **More than 450 species of birds reported from the Basin**
- **More than 75 species of mammals have been reported in the Basin**





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# *Imperiled Communities*

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- Over 130 species and natural communities in the Basin are imperiled for a variety of reasons.
- Several endangered species are endemic to the Basin.



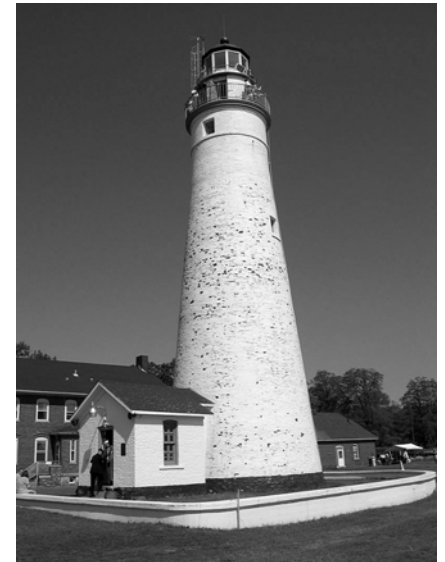


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## *Cultural Resources*

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- **More than 27,000 archeological sites recorded from coastal counties:**
  - **Archaeological sites and historic structures**
  - **National Register of Historic Places**
  - **Thousands of shipwrecks**
- **Only a small portion of Basin evaluated.**





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## *Economic Setting*

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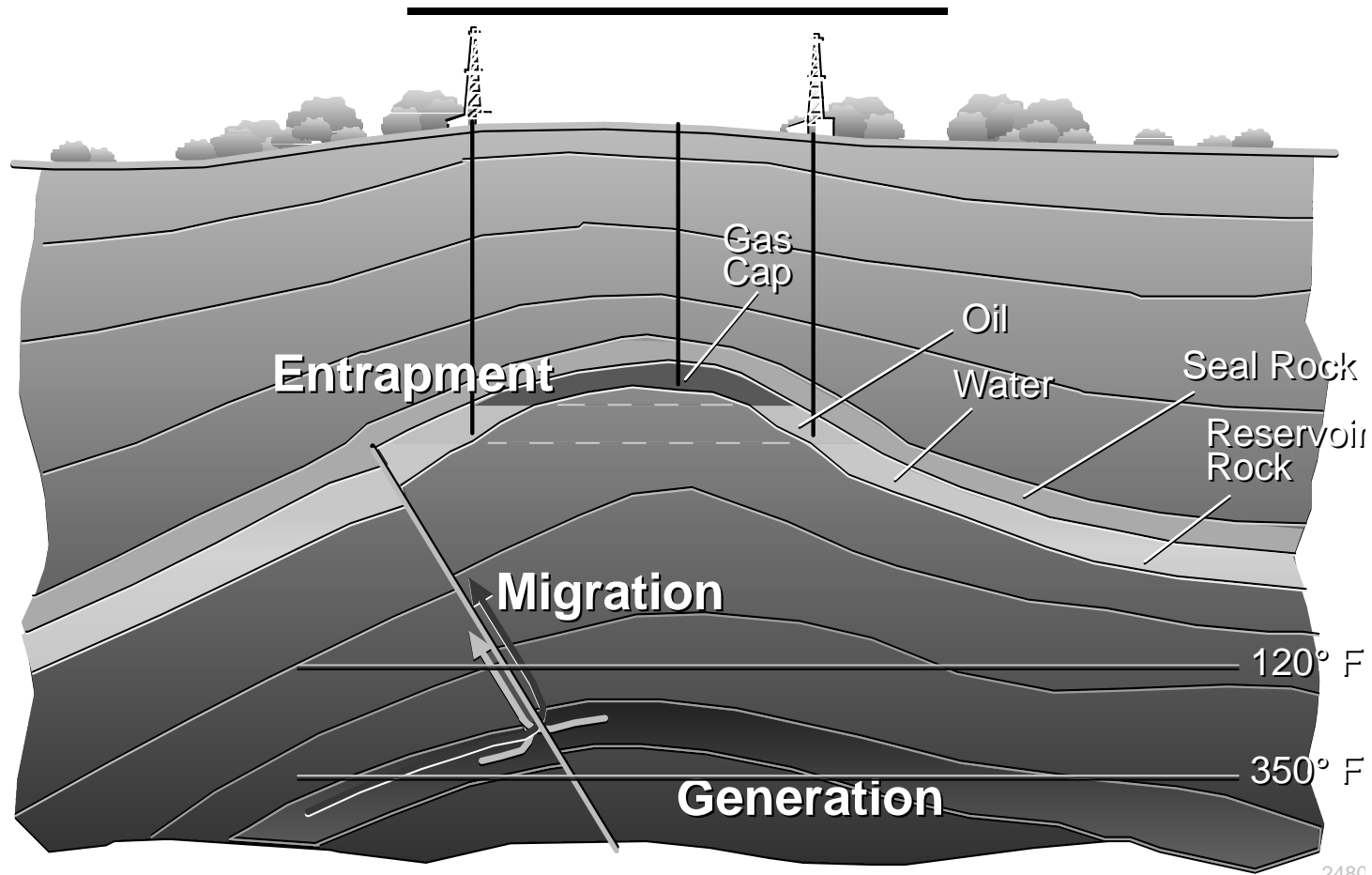
- **Basin economy accounted for:**
  - 16% of the U.S. GDP
  - 17% of U.S. water transport
  - 23% of U.S. manufacturing
  - 9% of U.S. agricultural production
  - 15% of U.S. recreational and entertainment products
- **Current oil and gas production less than 1% of total regional economy.**





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# *Oil and Gas Systems Of the Basin*



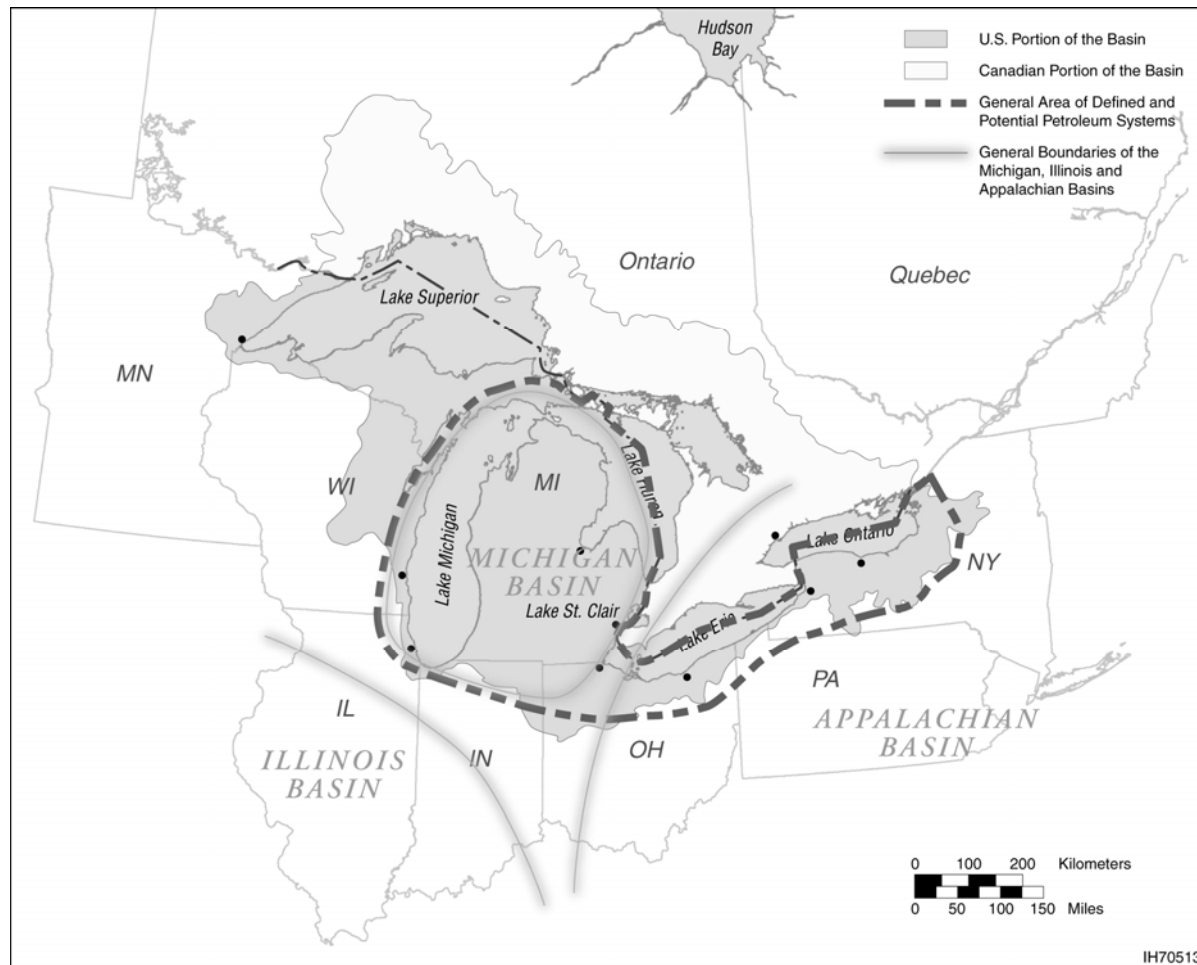
**Majority of oil and gas systems found in reservoirs  
beneath an impermeable rock formation.**





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# ***Known and Postulated Oil and Gas Systems in the Basin***



- **Known oil and gas systems in all States except Wisconsin and Minnesota.**
- **USGS assessments on Appalachian Basin (2003) and Michigan Basin (2005).**

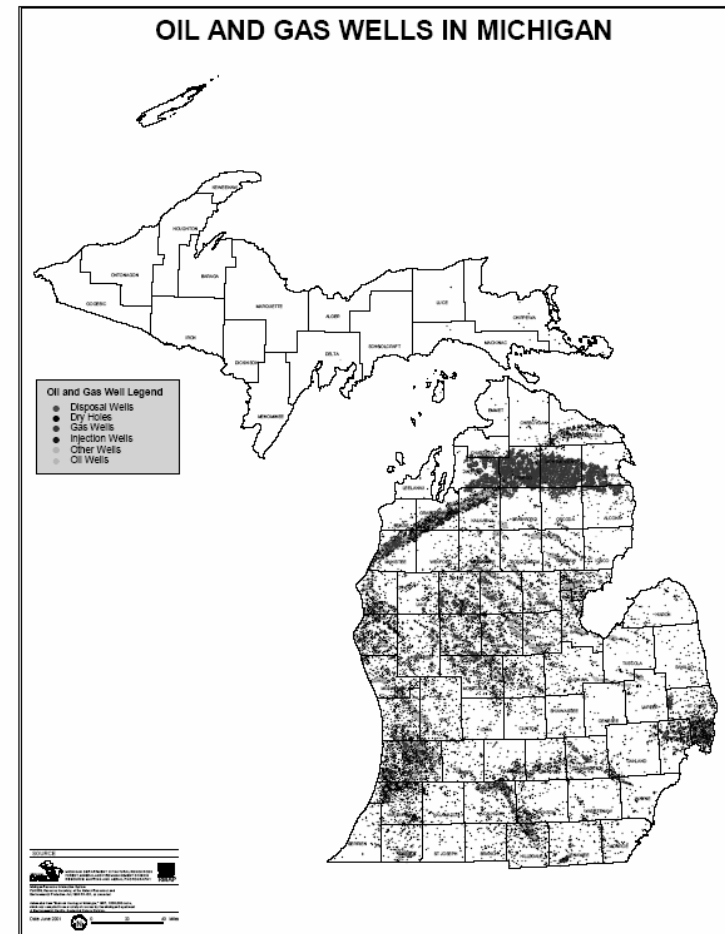


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## ***Current Oil and Gas Production in the Basin***

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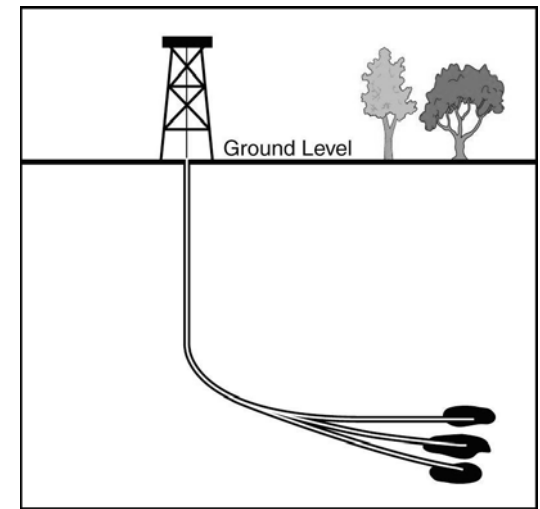
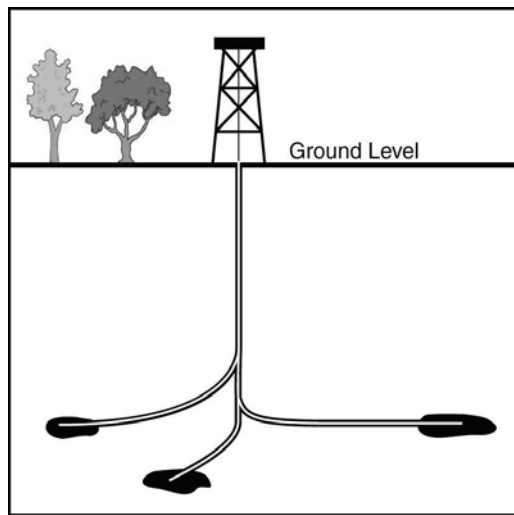
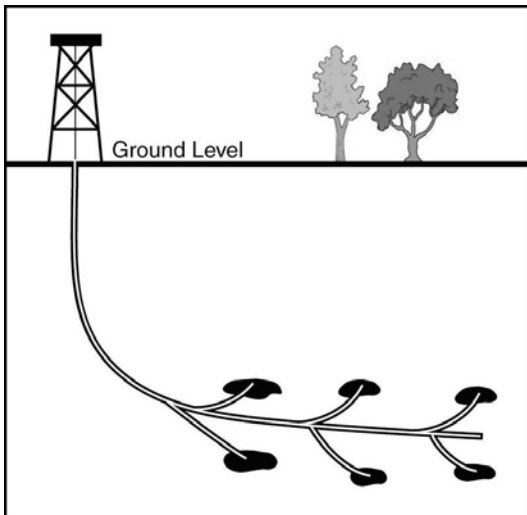
- **Production in all Basin States *except* Minnesota and Wisconsin.**
- **13 oil and gas wells drilled under Great Lakes in Michigan.**
- **Approximately 2,200 gas wells in Canada under Lake Erie.**





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# ***OIL AND GAS EXPLORATION AND DRILLING TECHNOLOGY***





# *Oil and Gas Development*

- **Multi-step process:**
  - **Exploration**
  - **Drilling and construction**
  - **Production and processing**
  - **Abandonment**
- **All steps require waste management.**

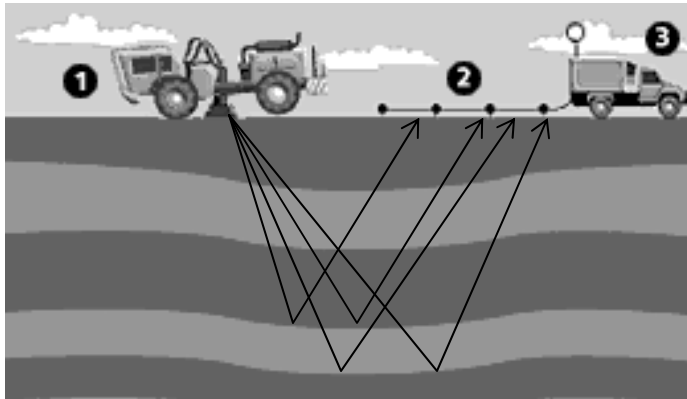




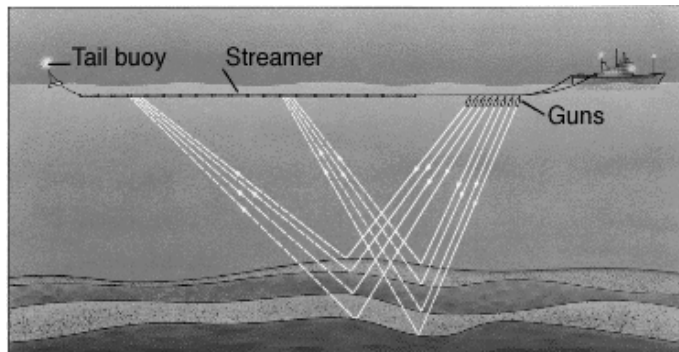
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# *Exploration*

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*Onshore Seismology*



*Offshore Seismology*

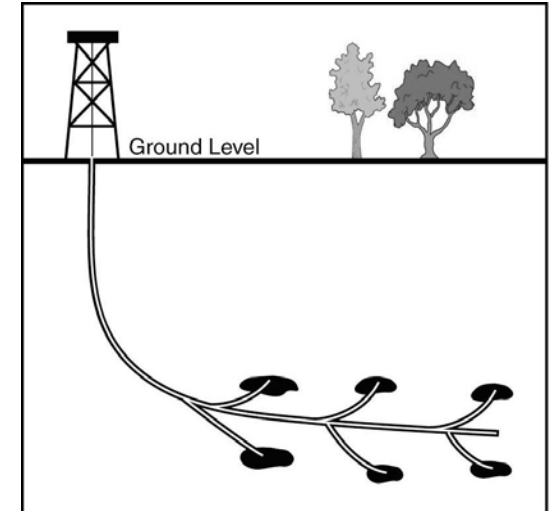
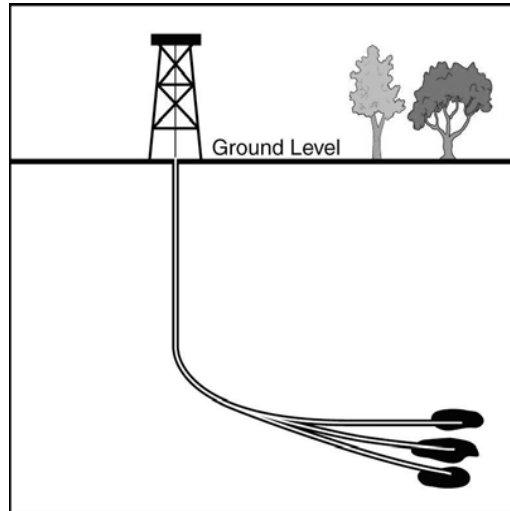
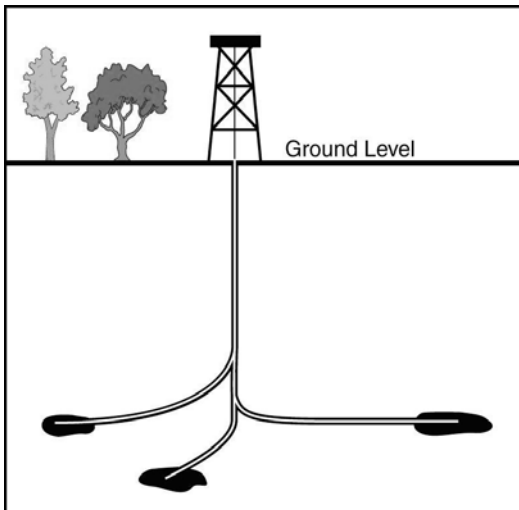
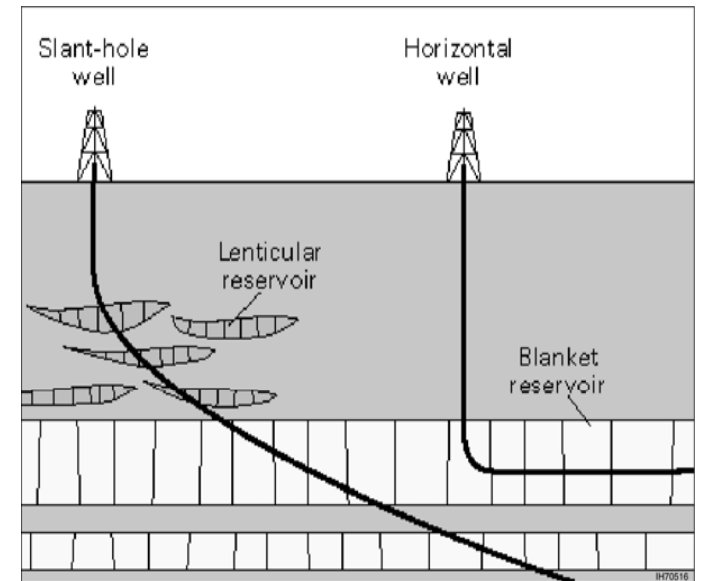
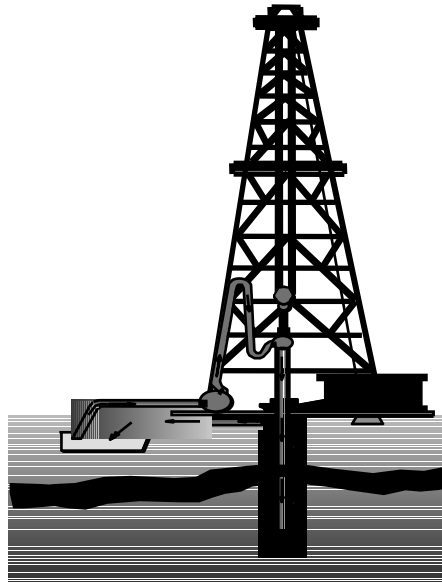
- **Exploration uses seismic waves to study subsurface formations.**
- **Seismic waves can be generated onshore and offshore.**



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# *Oil and Gas Drilling Techniques*

- **Straight Hole**
- **Directional**
- **Horizontal**
- **Multiple**





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# ***Post-Production Treatment and Storage***

---

## ***Gas and oil separators***

- **Natural impurities**
  - **Saltwater, gases,  
and other materials**
- **Temporary storage**
- **Processing and  
storage**
  - **Onsite or at  
centralized facility**



***Onsite oil storage tanks***



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# ***Drilling and Production Wastes***

---

## **Drilling Wastes:**

- **Drilling muds**
- **Drill cuttings**
- **Produced water**

## **Drilling Waste Disposal:**

- **Pits and landfills**
- **Land Application**
- **Licensed landfills**







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# *Pipeline Construction*

---

- **Offshore pipelines assembled on a barge, lowered into the water and buried**
- **Onshore pipelines assembled in place and buried**





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# ***OIL AND GAS RELEASE INCIDENTS***





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## ***Oil and Gas Release Record***

---

- **3 oil spills from offshore wells in Canada since 1959 (Lake Erie)**
- **No releases from Michigan wells drilled under lakes**
- **135 oil spills (average) reported annually in U.S. coastal harbors (1973-2001)**
  - **About 1,000 bbl per spill**
- **53 major oil spills reported (>10,000 bbl) in U.S. waters from 1967-1991**



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# ***Common Effects of Oil Releases and Exposure***

---

- **Primary exposure from direct physical contact**
- **Short-term effects:**
  - **Fouling of habitats and biota**
  - **Mortality of biota**
  - **Soil, sediment, or water contamination**
- **Long-term effects:**
  - **Reduced fish and wildlife populations**
  - **Elevated tissue concentrations**



*PCB exposure causes bird deformities like the crossed bill in this cormorant.*



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## ***Common Effects of Natural Gas Releases and Exposure***

---

- **Explosion and fire hazard**
- **Asphyxiation**
- **Toxic effects**
  - **Soft tissue irritation, headaches, fluid in lungs, loss of consciousness**
- **Little affect on water quality**



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# *Oil Spill Control and Cleanup*

---

- **Mechanical**
- **Chemical and Biological**
- **In-Situ Burning**
- **Also natural removal from:**
  - **Weathering**
  - **Evaporation**
  - **Biodegradation**





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# ***POTENTIAL EFFECTS OF OIL AND GAS DEVELOPMENT UNDER THE GREAT LAKES***





## ***NATURE OF POTENTIAL EFFECTS***

- **Potential for adverse effects with all activities:**
  - **Exploration**
  - **Drilling and Construction**
  - **Normal Operation**
- **Accidental release of oil**
  - **Greatest potential for most wide-spread effects**





## ***Factors Affecting Magnitude of Potential Effects***

---

- **Specific oil and gas development activity**
- **Existing land and water use**
- **Quality of resources present**
- **Facility design, size, location, and density**
- **Availability of existing infrastructure**
- **Use of good engineering practices**
- **Regulations governing protected species and natural resources**
- **Spill prevention and response requirements**



## ***Potential Effects of Exploration***

---

- **Primary effects from seismic surveys and drilling of exploratory wells:**
  - **Physical disturbance of habitats**
  - **Disturbance of biota**
  - **Disturbance of recreation and tourism**
- **Effects temporary and localized**
  - **Immediate vicinity of surveys**
  - **End with survey completion**



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# *Potential Effects of Drilling and Construction*

---

- **Primary affects to:**
  - Habitats
  - Biota
  - Recreation and tourism
  - Cultural resources
  - Access to sacred sites
  - Local land and water use
- **Localized effects**
- **Short- and long-term effects**





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# ***Potential Effects of Normal Operations***

---

- **Primary affects to:**
  - **Land and water use**
  - **Cultural resources**
  - **Access to sacred sites**
  - **Fish or wildlife**
- **Localized effects**
- **Long-term effects**





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# *Accidental Gas Release*

---

- **Primary effects due to:**
  - Explosion and fire hazard
  - Asphyxiation
  - Toxic effects
- **Primary affects to:**
  - Recreation and tourism
  - Residential communities
  - Cultural practices
- **Localized effects**
- **Short-term effects**
  - Release control
  - Dispersion via wind currents





## *Accidental Oil Release*

---

- **Greatest potential for long-term effects:**
  - **Water, sediment and soil**
  - **Terrestrial and aquatic biota**
  - **Cultural resources**
  - **Recreation and tourism**
  - **Land and water use**
  - **Local economies**



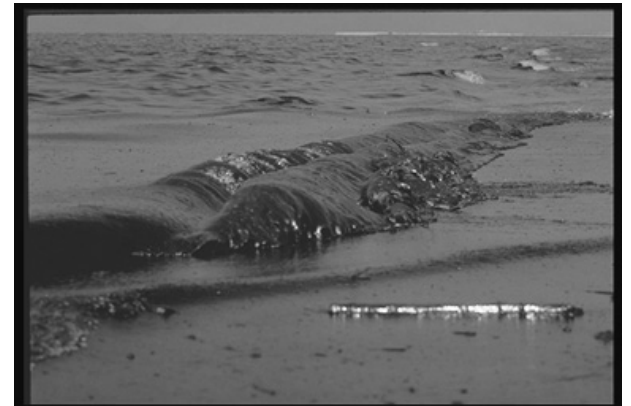


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# *Accidental Offshore Oil Release*

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- **Offshore spills could affect:**
  - Coastal habitats and land use
  - Fish and waterfowl
  - Recreation and tourism
  - Water withdrawals
  - Commercial shipping
- **Effects from cleanup activities**
- **Lake currents could spread release**
- **Short- and/or long-term effects**
- **Difficult to contain and cleanup**





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# ***Accidental Onshore Oil Release***

---

- **Accidental releases could affect:**
  - **Terrestrial habitats and biota**
  - **Aquatic habitats and biota**
  - **Groundwater**
  - **Recreation and tourism**
  - **Cultural resources**
- **Short- and/or long-term effects**
- **Release likely to be localized**
- **Potentially easier containment and cleanup**







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## ***SUMMARY AND CONCLUSIONS***



## ***Study Summary***

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- **Study authorized by Energy and Water Appropriations Act (2002)**
- **Permanent Federal ban (2005) on new permits and leases for oil and gas drilling in the Great Lakes**
- **Great Lakes Basin contains valuable ecological, cultural, and economic resources**
- **Potential oil and gas resources exist beneath Lakes Michigan, Huron, Erie, and Ontario**
- **Multiple uncertainties on resources and technologies**



## *Conclusions*

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- **Normal development could:**
  - **Disturb ecological and/or cultural resources**
  - **Cause visual and noise intrusion**
- **Accidental spills have the greatest potential for adverse impacts**
- **Potential effects could be mitigated by:**
  - **Use of multiple wells**
  - **Use of onshore directional drilling**
  - **Good engineering practices**
  - **Following existing regulations**
  - **Future advances in drilling and cleanup**



## ***Report Distribution***

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- **Final report available to the public at:**  
**<http://www.lrc.usace.army.mil/GrtLakes/OilGas/index-oilgas.html>**

- **Additional requests for information may be directed to:**

**U.S. Army Corps of Engineers  
Chicago District  
111 N Canal Street, Suite 600  
Chicago, IL 60606-7206  
(312) 846-5330  
<http://www.lrc.usace.army.mil>**



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***QUESTIONS ?***